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Can Cobalt and/or Nitrogen Sources be an Optimum Solution for Improving Characteristics of Broad Bean and Seed Yield?

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COBALT application is important for maintaining and improving plants properties. A field experiment was conducted on a sandy loam soil during the two consecutive winter seasons of 2020/2021 and 2021/2022 to examine the influence of cobalt and /or various nitrogen sources on broad bean (*Vicia faba L.*). The design was split plot with three replications. Results showed that cobalt applying to the soil increased nitrogenase enzyme activity which was parallel and associated to the increase nodules formation rate of broad bean with urea, ammonium nitrate and ammonium sulphate with compared to the control. Cobalt significantly enhanced growth, seed yield as well as nutritional studied and chemical constituents with various nitrogen sources. Cobalt application with ammonium sulphate resulted maximum values followed by ammonium nitrate while urea gave the lowest ones. Cobalt increased seed yield of broad bean by 13.5% with urea, 21.4% with ammonium nitrate and 24.0% with ammonium sulphate while 7.85% with control treatment. Thus, application of cobalt improved the nitrogen fertilizer use efficiency in newly reclaimed soil with broad bean plants.

Keywords: Nitrogenase enzyme activity; Vegetative parameters; Nutritional status; Nodulation parameters; Newly reclaimed soil; Mineral fertilizer; Cobalt application ; Legume crops.

1. Introduction

Broad beans (*Vicia faba L.*) are rich in nutrients (especially protein). Its protein content can reach 25.4%, making it the second most protein-rich edible bean after soybeans. Therefore, broad beans an important source of plant protein (Merga et al., 2019). It is one of the most important legumes in Egypt. It is vital in agriculture because of its high protein content in feed and food, ability to fix atmospheric nitrogen, and ability to grow efficiently in regenerating soils. (Afifi et al., 2017; Elkordy et al., 2022). Most of the newly reclaimed soils in Egypt don't offer the conditions for growing crops, because most of the newly reclaimed soils few in organic matter contents and major essential elements for plant growth. Nutrition by cobalt is a critical factor in determining the effectiveness of mineral fertilizers in promoting faba bean growth and yield (Gad et al., 2022). In Egypt, this crop can be cultivated successfully on newly reclaimed soil; therefore, understanding cobalt's beneficial effects is critical for increasing crop productivity and enhancing its nutritional value. (Elkordy et al., 2022). Cobalt is an important element in legumes because it is required by bacteria that fix nitrogen from the atmosphere. Thus deficiency of cobalt could result in nitrogen deficiency. Cobalt also promotes many developmental processes in other plants (Khatab, 2016). Cobalt is necessary for the formation of B_{12}, which is essential vitamin for human nutrition. Unlike other heavy metals, it is less hazardous to health of human and can be consumed up to 8 ppm

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daily (González-Montaña et al., 2020). Cobalt is required for the growth of rhizobia, a specialized group of bacteria involved in nodulation of legumes and the fixation of nitrogen from atmosphere into amino acids and proteins in legumes (Minz et al. 2018, Hu et al. 2021). Vitamin B12 is synthesized by rhizobia and circulates in hemoglobin. The hemoglobin content in root nodules is directly related to nitrogen fixation. As a result, its insufficiency shows as decreased vitamin B12 synthesis and decreased nitrogen fixation (Osman et al., 2021). Mintz et al. (2018) pointed out that the presence of cobalt among coenzymes in the root nodules of various legumes proved cobalt's role in nitrogen fixation. In 2004, Castro and colleagues discovered important findings: when phaseolus seeds were treated with cobalt, it had a considerable impact on their nodulation, dry weight, physiological quality, vigor, protein, and elements content. They noted that cobalt had the greatest effect on nodulation and number of active nodules. Thus it saved 20% of the recommended nitrogen fertilizer for soybean plants as well as significantly decreasing the total nitrogen accumulation in their shoots. This discovery highlights the potential of cobalt to greatly influence the growth and development of phaseolus seeds. According to Gad (2006), the inclusion of cobalt in media for pea plants had a significant impact on their nutrient absorption, even at lower levels. As a result, cobalt can decrease the usage of mineral and organic nitrogen fertilizers, reducing it about 25% and 33% of the recommended amounts respectively, under experiment conditions. This resulted in improved growth of roots and shoots, as well as increased number and weight of nodules. Additionally, it led to higher levels of macronutrients, micronutrients, pea pods, yield and quality of seeds. Moreover, cobalt minimized the accumulation of harmful nitrates, ensuring a safer product for human consumption (Banerjee et al. 2021). According to Gad et al. (2011), the addition of cobalt to the soil, significantly increased the ability of Rhizobium bacteria to fix N2 and produce healthy faba bean plants. Gad (2012) also stated that cobalt had a significantly positive impact on the parameters of groundnut root nodules when compared to the control. The addition of 8 ppm of cobalt resulted in the highest number of nodules as well as the greatest fresh and dry weights. The encouragement of nodule development resulted in an increase in the effectiveness of rhizobium bacteria to perform with N_2 fixation and save 20% from nitrogen required at high capacity to produce healthy plants. According to Gad et al. (2013), cobalt had a significant synergistic influence on the characteristics of cowpea root nodules compared to the untreated plants. Cobalt levels significantly enhanced nitrogenase activity which was parallel and associated with an increase in the numbers of nodules, weights and its efficiency of soybean compared to the control (Gad et al. 2014).

Expansion of agricultural lands to desert areas has great improvement of food security and farmer's income, therefore supporting bioenergy production and the availability of raw materials in Egypt. To meet projected food demand in Egypt, an additional of agricultural land may be required with the cultivation of leguminous crops and addition of nutrients. Wherefore, the current study was conducted to evaluate the performance of cobalt on characteristics of broad bean with various sources of nitrogen fertilizers in newly reclaimed soil in Egypt

2. Materials and Methods

2.1. Study Site

The current study was conducted at the National Research Centre's Research and Production Station in El-Nubaria, El-Beheira Governorate, Egypt (latitude 30^{o} 30' 1.4"N, and longitude 30^{o}19' 10.9"E), and 21m above sea level (Fig. 1) The climate of the study area is arid. It is characterized by a short rainy season, long hot summer and high relative humidity small diurnal temperature variations.

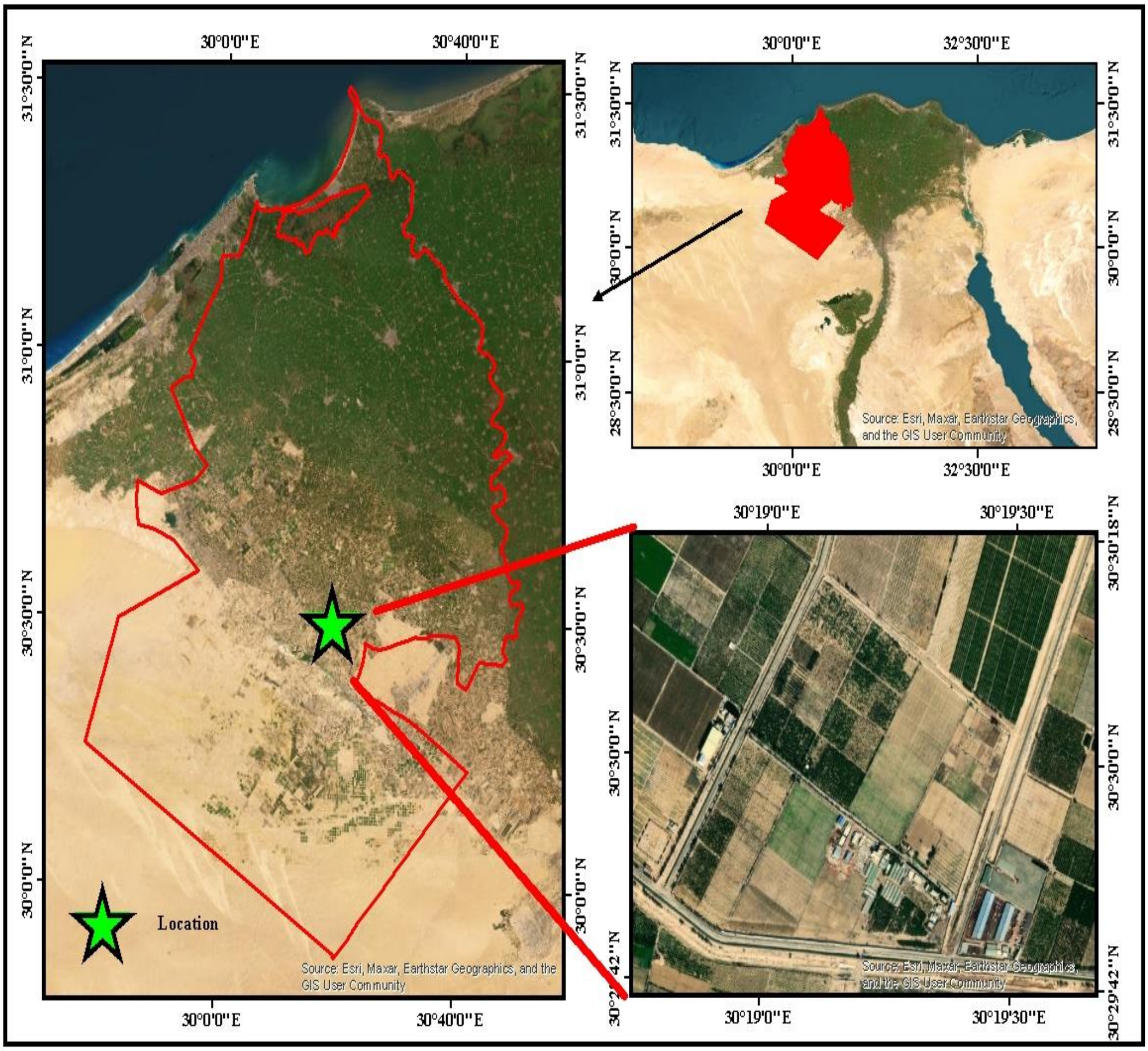

Fig. 1. Location map of the studied site.

Soil samples were collected from the surface layer (30 cm soil depth) and classified as Typic *Haplocalcids*. Particle size distribution was determined using the method given by Klute (1986). The soils were air-dried and passed through 2 mm sieve. Soil pH, EC, Organic matter, $CaCO_3$, total N, available P, K, Mn, Fe, Cu and Zn were carried out according to Black et al. (1982). Determinations of total, soluble and available cobalt were run as described by Cottenie et al. (1982). As shown in Table (1).

Table 1. Particle size distribution and chemical properties of the studied soil.

Property	Value	Property	Value
Sand	76.20	Available P, mg kg^{-1}	131.65
Silt	20.70	Available K, mg kg^{-1}	42.78
Clay	3.10	Available Fe, mg kg^{-1}	4.78
Textural	Sandy loam	Available Mn, mg kg^{-1}	2.91
Soil organic matter, g kg^{-1}	1.90	Available Cu, mg kg^{-1}	5.22
$CaCO_3$, g kg^{-1}	31.70	Available Zn, mg kg^{-1}	3.73
pH, (1:2.5 soil: water)	8.20	Soluble Co, mg kg^{-1}	0.37
EC, dS/m^{-1} (soil paste extract)	1.10	Available Co, mg kg^{-1}	2.77
Total-N, mg kg^{-1}	150.34	Total Co, mg kg^{-1}	9.66

2.2. Treatments and experimental design

A field experiment was designed to study the effect of cobalt on broad bean with various sources of nitrogen fertilizers during the two consecutive winter seasons of 2020/2021 and 2021/2022. The design was split plot with three replicates. The main plot was devoted for cobalt application (without – with cobalt) and sub plots were occupied by nitrogen sources (Control (without nitrogen), Urea, Ammonium nitrate and Ammonium sulphate). The area of the plot was $15m^2$ (5m long and 3 m width). Each row was planted with 10 plants, spaced 50cm on one side of the rows. Broad bean seeds (*Vicia faba cv. Koprosy*) were sowing on November 8 and 11th of 2020/2021 and 2021/2022 seasons, under drip irrigation system. 50kg/fed Potassium Sulphate (48% K_2O) and 200kg/fed calcium super phosphate (P_2O_5 15.5%) were added during soil preparation. At the third true leaf, cobalt at 12 mg/L was added as cobalt sulphate to the irrigation water (drip system). All agricultural practices were carried out as recommended by Egypt's Ministry of Agriculture.

2.3. Sampling and measurements

After 50 days of sowing, the number and weight of nodules were recorded. Nitrogenase activity values were measured as µmol C_2H_4 /g/h according to Hardy (1968). According to FAO (1980), after 75 days of seeding, all growth characteristics of broad bean plants such as plant height, number of branches and leaves, as well fresh and dry weights of shoot and root were recorded. Broad bean yield parameters such as pods number/plant, length, diameter and weight of pods/plant as well as the weight of seeds/pod, 100 seed weight, and dry seed yield (ton/fed) were recorded after 120 days from sowing.

The percentage of total proteins, total carbohydrates, total soluble sugars and Vitamin (A) of seeds will be determined according to **A.O.A.C (1995).**

For chemical analysis, seeds were sampled from the intact plant for each treatment and oven dried for 48 hr. at 70ºC before ground and kept for chemical analysis. For extraction, a weight of 0.2g finely ground and digested using a mixture of sulfuric acid (H_2SO_4) with hydrogen peroxide (H_2O_2). Macronutrients (N, P, and K) and Micronutrients (Zn, Mn, Cu, Fe as well cobalt) were run out according to the method described by **Cottenie *et al.* (1982).**

2.4. Statistical analyses

All data were statistically analyzed using the **MSTATC (Freed, 1991)** microcomputer program and means were compared using Duncan's Multiple Range (DMR) test described by **Waller and Duncan (1969)**. Combined analysis of both seasons was discussed**.**

3. Results and Discussion

3.1. Nodulation rate and nitrogenase activity

The present data in Table (2) clearly demonstrated that soil applied cobalt at 12 mg/L had a significant favorable influence on nodulation parameters of plant roots compared with control plants. Table (2) also indicated that all nitrogen fertilization can be arranged in decreasing order as follows: Ammonium sulphate >Ammonium nitrate > Urea. This was due to the possible beneficial effect of sulphur on encourages nodulation in legumes. The highest values of nodules no. per plant (161.8) and nitrogenase enzyme activity (23.4 Mmol C2H4/g/h) were obtained by ammonium sulphate with cobalt application. The control (without cobalt) had the lowest nodulation parameters of broad bean.

Table 2. Influence of cobalt on nodulation parameters on plants root under various nitrogen sources (average of two seasons).

Treatments		Nodules No. per plant	Fresh weight of nodules (g)	Dry weight of nodules (g)	Nitrogenase enzyme activity Mmol C_2H_4/g/h
Cobalt application					
	Without cobalt	104.57 b	9.79 b	3.27 a	17.05 b
	With cobalt	133.74 a	14.44 a	4.10 a	19.83 a
Nitrogen sources					
	Control	80.75 d	8.55 c	2.70 c	13.35 d
	Urea	116.95 c	12.21 b	3.59 b	18.30 c
	Ammonium Nitrate	134.67 b	13.51 a	4.09 a	20.41 b
	Ammonium Sulphate	144.25 a	14.20 a	4.36 a	21.70 a
Interaction effect					
Without cobalt	Control	63.6 g	6.79 e	2.34 e	12.3 f
	Urea	108.2 e	9.85 d	3.29 cd	16.7 d
	Ammonium Nitrate	119.8 d	10.94 cd	3.62 bc	19.2 c
	Ammonium Sulphate	126.7 c	11.58 c	3.81 b	20 c
With cobalt	Control	97.9 f	10.3 cd	3.06 d	14.4 e
	Urea	125.7 cd	14.56 b	3.88 b	19.9 c
	Ammonium Nitrate	149.5 b	16.08 a	4.56 a	21.7 b
	Ammonium Sulphate	161.8 a	16.81 a	4.91 a	23.4 a

Different letters in the same column indicate significant differences according to Duncan test at ($P \leq 0.05$).

Broad bean plants illustrated that the higher values of nodules number / plant, fresh and dry weights of nodules / plant as well as nitrogenase enzyme activity were obtained harmony with those obtained by **Nasef et al (2004)** who found that application of cobalt at 15 ppm showed significantly higher nodule numbers and weight, nodule nitrogen content, leghemoglobin content, seed yield and total biomass production of peanut plants.

Balachander *et al.* (2003) added that cobalt had a significant impact on cowpea nodule parameters i.e. total nodule, nodule number/plant and nodules fresh and dry weights compared to untreated plants. Cobalt could be used as a coenzyme confirming the essential role of cobalt in biological nitrogen fixation in legumes. **Baddour *et al.* (2021)** reported similar results.

3.2. Vegetative growth

Data in Table (3) revealed that the tested nitrogen sources used with cobalt had improved broad bean vegetative growth characteristics compared to untreated plants. The maximum vegetative growth parameters were recorded in the broad bean plants supplied with cobalt at 12 mg/l and 20 units of ammonium sulphate. These findings are in good accordance with those obtained by **Gad et al. (2022).**

Table 3. Influence of cobalt on vegetative growth parameters of broad bean under various nitrogen fertilizers (average of two seasons).

Treatments		Plant height (cm)	Number/plant		Fresh weight /plant		Dry weight /plant	
			Branches	Leaves	Shoot	Root	Shoot	Root
Cobalt application								
	Without cobalt	93.78 b	7.57 b	56.17 b	500.80 b	94.10 b	124.60 b	22.83 b
	With cobalt	109.75 a	10.46 a	67.28 a	552.475 a	108.21 a	139.75 a	25.40 a
Nitrogen sources								
	Control	84.55 d	6.48 d	52.90 d	445.25 d	86.70 d	117.46 d	18.99 d
	Urea	99.50 c	8.82 c	60.70 c	521.45 c	96.12 c	129.90 c	20.27 c
	Ammonium Nitrate	107.30 b	9.84 b	64.20 b	556.95 b	105.30 b	136.95 b	26.49 b
	Ammonium Sulphate	115.70 a	10.93 a	69.10 a	582.90 a	116.50 a	144.40 a	30.71 a
Interaction effect								
Without cobalt	Control	79.6 f	5.91 g	46.6 f	438.5 e	83.6 g	112.3 f	18.34 e
	Urea	91.7 e	7.23 ef	54.9 e	489.2 d	89.8 f	123.2 e	20.08 d
	Ammonium Nitrate	98.8 d	8.07 e	58.6 de	528.7 c	96.0 e	129.3 d	23.78 c
	Ammonium Sulphate	105.0 c	9.05 d	64.6 c	546.8 c	107.0 c	133.6 c	29.11 b
With cobalt	Control	89.5 e	7.04 f	59.2 d	452.0 e	89.8 f	122.61 e	19.64 de
	Urea	107.3 c	10.4 c	66.5 bc	553.7 c	102.4 d	136.61 c	20.45 d
	Ammonium Nitrate	115.8 b	11.6 b	69.8 ab	585.2 b	114.6 b	144.6 b	29.2 b
	Ammonium Sulphate	126.4 a	12.8 a	73.6 a	619.0 a	126.0 a	155.2 a	32.3 a

Different letters in the same column indicate significant differences according to Duncan test at (P≤0.05).

Data presented in Table (3) also showed that ammonium sulphate recorded the greatest values of broad bean growth parameters followed by ammonium nitrate followed by Urea. These findings are agreed with those reported by **Gad *et al*. (2009)** who found that the application of nitrogen fertilizers caused promotive effect of spinach growth parameters.

3.3. Yield characteristics

Data in Table (4) clearly indicated that treatments applied with cobalt had a favorable effect on broad bean yield attributes such as pods weight, pod length and diameter as well as number of pods per plant, seeds weight per pod and weight of 100 seeds compared with untreated treatment. It seemed that cobalt improved plant growth and productivity by increasing nitrogen fixation ability, nutritional quality as well as physio-biochemical reactions. Cobalt application increased 100-seeds weight of broad bean by 4.55% with urea, 8.91% with ammonium nitrate and 11.40% with ammonium sulphate while 6.91% with control treatment.

Results clearly showed that highest dry yield was obtained from ammonium sulphate with cobalt 12 mg/l, which was 1.684 ton/fed, followed by ammonium nitrate with cobalt, which was 1.449 ton/fed. The lowest dry yield obtained from untreated treatment, which was 0.828 ton/fed as shown in fig. 2. These findings are in harmony with those obtained by **Abdul Jaleel *et al.* (2008,2009)** who discovered that adding cobalt to soil media increase all growth and yield parameters in both maize (*Zea maize L.*) and green gram (*Vigna radiate*) plants.

Table 4. Influence of cobalt on yield characteristics of broad bean under various nitrogen sources (average of two seasons).

Treatments		Pod				Seeds	
		No. per plant	Weight per plant (g)	Length per plant (cm)	Diameter (cm)	Weight per pod (g)	Weight of 100 seeds (g)
Cobalt application							
	Without cobalt	15.84 b	13.30 b	12.42 b	1.45 b	4.31 a	290.45 b
	With cobalt	17.01 a	18.15 a	13.21 a	1.66 a	4.81 a	340.10 a
Nitrogen sources							
	Control	14.30 d	12.43 d	11.43 d	1.36 d	3.74 c	193.80 d
	Urea	15.98 c	16.10 c	12.66 c	1.52 c	4.49 b	283.50 c
	Ammonium Nitrate	17.14 b	16.74 b	13.33 b	1.64 b	4.86 a	359.95 b
	Ammonium Sulphate	18.27 a	17.64 a	13.84 a	1.70 a	5.14 a	423.85 a
Interaction effect							
Without cobalt	Control	14.22 f	10.03 g	11.16 g	1.27 e	3.65 d	139.0 h
	Urea	15.08 e	13.33 f	12.27 ef	1.44 d	4.18 cd	277.2 f
	Ammonium Nitrate	16.39 d	14.24 e	12.78 de	1.52 c	4.59 bc	344.6 d
	Ammonium Sulphate	17.66 b	15.60 c	13.45 bc	1.56 c	4.80 b	401.0 b
With cobalt	Control	14.38 f	14.82 d	11.70 fg	1.44 d	3.32 d	148.6 g
	Urea	16.87 c	18.87 b	13.04 cd	1.59 c	4.79 b	289.8 e
	Ammonium Nitrate	17.89 b	19.24 ab	13.88 ab	1.76 b	5.03 ab	375.3 c
	Ammonium Sulphate	18.88 a	19.67 a	14.23 a	1.84 a	5.48 a	446.7 a

Different letters in the same column indicate significant differences according to Duncan test at (P≤0.05).

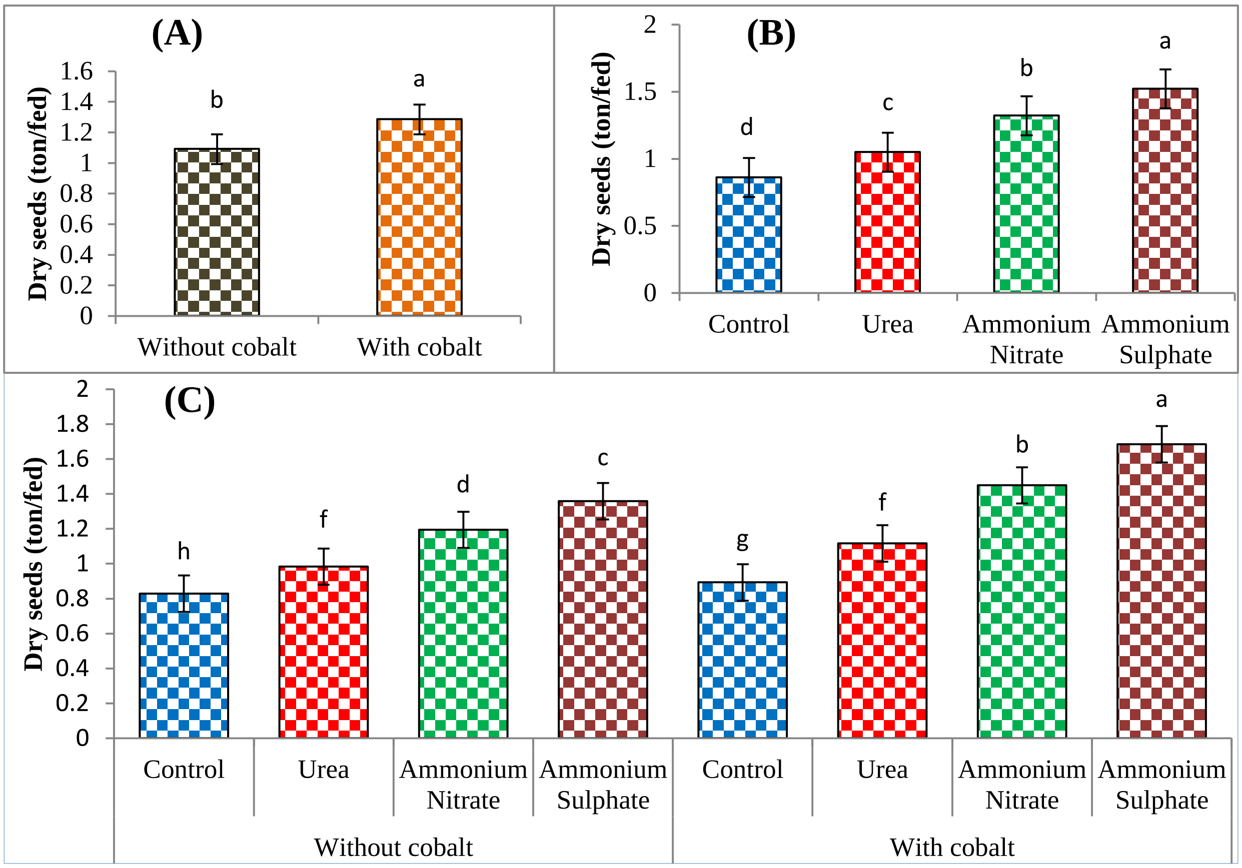

Fig. 2. Influence of cobalt on dry seeds of broad bean under various nitrogen sources (average of two seasons), A: cobalt application, B: nitrogen sources and C: interaction effect.

Confirm these results **Gad *et al*. (2022)** who declared that the interaction between cobalt applications and different nitrogen fertilization resulted in the greatest yield parameters in lentil compared with control.

3.4. Nutritional status

Data in table (5) clearly indicated that treatments applied with cobalt had a favorable effect on N% content in seeds with various sources of nitrogen. This finding maybe due to the function of cobalt in increasing the mass of nodulation and N fixation that increased the nitrogen use efficiency. The highest value of N% was obtained by using cobalt with ammonium sulphate which was 3.97.

Data in Table (5) also showed positive impact of cobalt on mineral composition (N, K, P, Cu, Mn, Fe and Zn) as well cobalt of broad bean seeds. These findings are consistent with those of **Jana *et al.* (1994)** who pointed out that cobalt had a promotive influence for better status of all minerals in groundnut seeds with compared to control. **Jayakumar *et al.* (2008)** reveal that cobalt applied to the soil at 50 ppm significantly increased all minerals content of black gram when compared with untreated plants.

Table 5. Influence of cobalt on nutritional status of Broad bean seeds under various nitrogen fertilizers (average of two seasons).

Treatments		Macronutrients (%)			Micronutrients (mg/L)				Cobalt (mg/L)
		N	P	K	Mn	Zn	Cu	Fe	
Cobalt application									
	Without cobalt	2.88 b	0.459 a	1.62 a	20.55 b	24.94 b	18.38 b	167 a	0.87 b
	With cobalt	3.08 a	0.464 a	1.68 a	22.10 a	28.48 a	19.48 a	167 a	6.01 a
Nitrogen sources									
	Control	2.13 d	0.434 c	1.32 d	17.95 d	22.05 d	16.10 d	163 d	2.01 d
	Urea	2.38 c	0.461 b	1.65 c	20.25 c	24.15 c	17.85 c	167 c	3.70 c
	Ammonium Nitrate	3.61 b	0.468 b	1.78 b	23.05 b	31.10 a	19.60 b	165 b	3.81 b
	Ammonium Sulphate	3.81a	0.484 a	1.85 a	24.05 a	29.52 b	22.15 a	172 a	4.24 a
Interaction effect									
Without cobalt	Control	2.08 e	0.432 d	1.30 f	17.3 h	21.4 h	15.5 h	168 c	0.79 f
	Urea	2.32de	0.459 c	1.61 e	19.7 f	23.9 f	17.3 f	172 b	0.83 f
	Ammonium Nitrate	3.49 c	0.466 bc	1.76 c	22.2 d	25.6 d	19.0 d	161 d	0.89 ef
	Ammonium Sulphate	3.64 bc	0.481 ab	1.82 ab	23.0 c	28.8 c	21.7 b	167 c	0.96 e
With cobalt	Control	2.18 ef	0.437 d	1.34 f	18.6 g	22.7 g	16.7 g	158 e	3.23 d
	Urea	2.43 d	0.463 bc	1.69 d	20.8 e	24.4 e	18.4 e	163 d	6.57 c
	Ammonium Nitrate	3.73 b	0.471 bc	1.81 bc	23.9 b	36.6 a	20.2 c	169 c	6.73 b
	Ammonium Sulphate	3.97 a	0.486 a	1.87 a	25.1 a	30.2 b	22.6 a	178 a	7.52 a

Different letters in the same column indicate significant differences according to Duncan test at ($P \leq 0.05$).

Data reflected also the superiority of cobalt with ammonium sulphate fertilizer followed by ammonium nitrate while urea fertilizer gave the lowest nutritional status.

Gad *et al*. (2022) added that all cobalt levels increased minerals composition in common bean seeds such as N, P, K, Zn, Mn and Fe with the studied nitrogen fertilizer when compared with control plants.

The superiority of cobalt with ammonium sulphate fertilizer maybe related to the role of sulphur in reducing the degree of soil pH reaction to the extent that it can promote the decomposition of insoluble elements in the soil and make elements more available. Abd El-Hafez *et al.* (2016)

3. 5. Chemical constituents

According to the data in Fig. 3 cobalt addition with various nitrogen sources significantly increased all the mentioned parameters. The content of proteins in broad bean seeds significantly increased as influenced by cobalt with the studied nitrogen sources because cobalt is required for the growth of rhizobia that is involved in nodulating legumes and fixing nitrogen from the atmosphere to amino acids and proteins (Minz *et al.* 2018, Hu *et al.* 2021. Data in Fig. 4 Indicated that cobalt application significantly increased total soluble sugar and vitamin A in broad bean seeds. These results are in agreement with those reported by Vijayaregan *et al.* (2009) who declared that application of cobalt at 50 mg/kg soil had a promotive effect of biochemical of groundnut seeds like amino acids, total carbohydrates, starch and total soluble sugars with compared to the control. Support these findings Gad *et al.* (2022) who found that applying cobalt at 10 mg/L significantly improved the percentage of total protein, total carbohydrate, starch and total soluble sugars in common bean seed with compared to control plants.

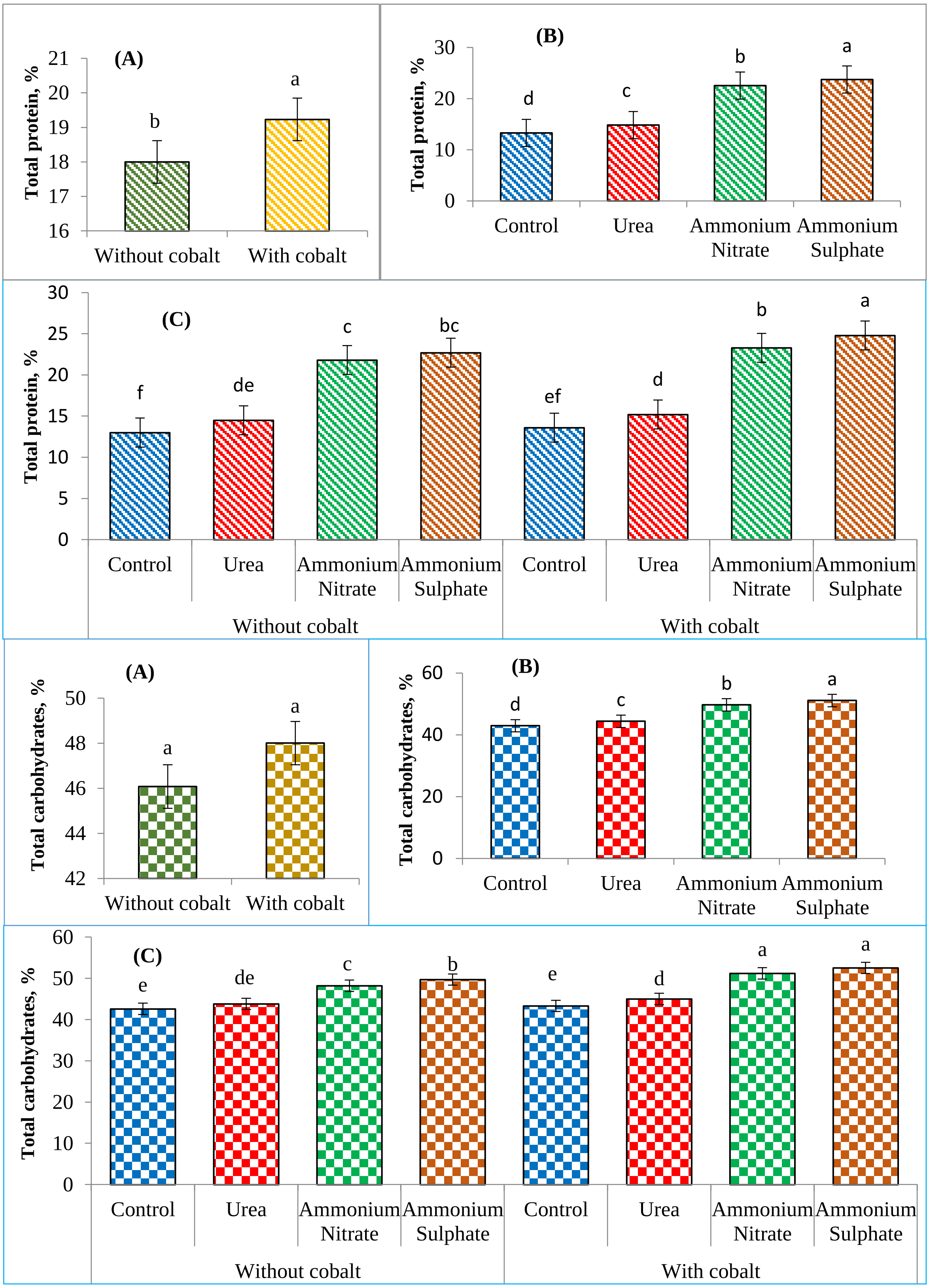

Fig. 3. Influence of cobalt on (protein and carbohydrates %) of Broad bean seeds under various nitrogen sources (average of two seasons), A: cobalt application, B: nitrogen sources and C: interaction effect.

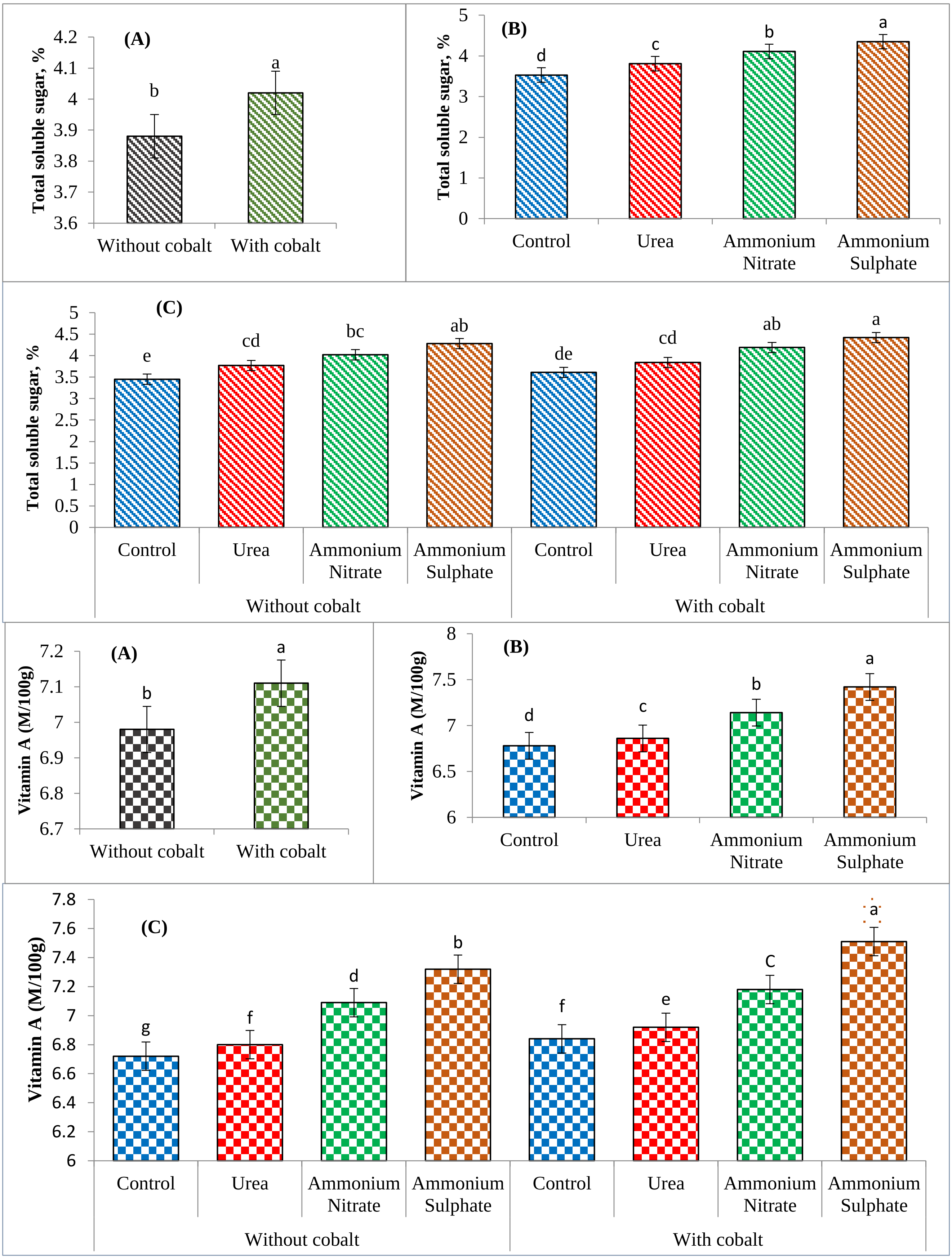

Fig. 4. Influence of cobalt on (Total soluble sugar and vitamin A) of Broad bean seeds under various nitrogen sources (average of two seasons), A: cobalt application, B: nitrogen sources and C: interaction effect.

4. Conclusion

Cobalt is necessary for leguminous crops and nitrogen-fixing bacteria. It is an essential component of cobalamin, which is required for the activities of several enzymes and co-enzymes and is responsible for formation of leghemoglobin, involve in nitrogen fixation in nodules of leguminous plants. Application of cobalt significantly increased nitrogenase enzyme activity which was related to the increase in nodules formation rate of broad bean plants under nitrogen sources with compared to the control. It plays an essential role to plant growth and development. Nitrogen treatments with cobalt had a favorable effect on broad bean yield attributes. Furthermore, application of ammonium sulpate with cobalt could be available way for improving broad bean plant productivity and its biological value in newly reclaimed soil conditions.

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هل الكوبلت مع/أو مصادر النيتروجين الحل الأمثل لتحسين خصائص الفول والإنتاجية؟

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يعد استخدام الكوبلت مهمًا للحفاظ على خصائص النباتات وتحسينها. أجريت تجربة حقلية فى التربة المستصلحة حديثا خلال الموسمين الشتويين 2021/2020 و 2022/2021 لدراسة تأثير الكوبلت على خصائص الفول والانتاجية مع الأسمدة النيتروجينية المختلفة. صممت التجربة باستخدام تصميم القطع المنشقة فى ثلاث مكرارات. تم توزيع معاملات الكوبلت فى القطع الرئيسية (بدون - مع الكوبلت) ومصادر النتروجين فى القطع الشقية (كنترول (بدون نيتروجين)، اليوريا، نترات الأمونيوم وكبريتات الأمونيوم). أظهرت النتائج أن الكوبلت أدى إلى زيادة نشاط إنزيم النتروجينز والذي كان متوازيا مع زيادة معدل تكوين العقيدات في جذورالفول تحت ظروف اليوريا ونترات الأمونيوم وكبريتات الأمونيوم مقارنة بالكنترول. وقد عزز استخدام الكوبلت بشكل كبير النمو وإنتاجية البذور بالإضافة إلى المكونات الغذائية والكيميائية التي تمت دراستها مع مصادر النيتروجين المختلفة. وقد أدى إضافة الكوبلت مع كبريتات الأمونيوم إلى أعلى القيم تليها نترات الأمونيوم بينما أعطت اليوريا أقل القيم. أدى الكوبلت إلى زيادة إنتاجية محصول البذور بمقدار 13.5% مع اليوريا و21.4% مع نترات الأمونيوم و24.0% مع كبريتات الأمونيوم بينما 7.85% بالمقارنة مع الكنترول. وبالتالي فإن استخدام الكوبلت أدى إلى تحسين كفاءة استخدام الأسمدة النيتروجينية المختلفة في التربة المستصلحة حديثا مع نباتات الفول.

الكلمات المفتاحية: نشاط إنزيم النيتروجينيز - الصفات الخضرية – الحالة الغذائية – صفات العقد البكترية – الأراضي المستصلحة حديثا - الأسمدة المعدنية – تطبيق الكوبلت – المحاصيل البقولية.